PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

EX PARTE NI et al.

Application for Patent

Filed: June 30, 1999

Serial No. 09/347,583

FOR:

MOVEABLE BARRIER FOR MULTIPLE ETCH PROCESSES

APPEAL BRIEF

CERTIFICATE OF MAILING

I hereby certify that this correspondence is being deposited with the United States Postal Service as First Class Mail in an envelope addressed to: Assistant Commissioner for Patents, Washington, DC 20231 on July 3, 2001.

Signed: Deborah Neill

Deborah Neill

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(1) REAL PARTY IN INTEREST

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(2) RELATED APPEALS AND INTERFERENCES

N/A

(3) STATUS OF CLAIMS

Claims 1-13 are pending in this application. Claims 1-22 were submitted with the application as filed. Claims 14-22 were cancelled in response to a restriction requirement in the first Office Action. Claim 10 was amended in a response to the first Office Action to correct a typographical error. Claims 1-13 were rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 6,042,687 to Singh et al. (hereinafter referred to as "Singh") in view of U.S. Patent 5,552,124 to Su (hereinafter referred to as "Su"). All rejections of claims 1-13 are appealed.

(4) STATUS OF AMENDMENTS

The Appellant filed an amendment in response to the first Office Action to correct a typographical error in claim 10. Such amendment was entered. No amendments have been made since that time.

(5) SUMMARY OF INVENTION

All the claims on appeal are directed at a semiconductor-based device processing apparatus. More specifically, claims 1-13 recite a semiconductor-based device processing apparatus comprising a diffusion barrier having multiple positions relative to a wafer (See generally, page 3, lines 18-26; page 5, lines 26 to page 9, line 2; Figures 2-3). The processing apparatus is suitable for use in chemically driven etch processes and ion-assisted etch processes, such as plasma enhanced etch processes. One known approach for improving etch rate uniformity in a chemically driven etch process is to install a diffusion barrier around the wafer perimeter. However, diffusion barriers are not used during ion-assisted etch processes. As a result, separate processing apparatus are often used when both ion-assisted etching and chemically driven etching is to be performed (See generally, page 2, line 3 to page 3, line 12). The present invention comprises a diffusion barrier having multiple positions relative to the

wafer. In one position, the diffusion barrier acts to inhibit diffusion of neutral species which may compromise etch uniformity or quality of a chemically driven etch process. In another position, the barrier is recessed so as to not disturb an ion-assisted etch process (See generally, page 3, lines 18-26; page 5, lines 26 to page 9, line 2; Figures 2-3).

(6) ISSUES

The issues, which Appellant believes to be most pertinent to the present appeal, include:

A) Whether U.S. Patent No. 6,042,687 to Singh, and/or U.S. Patent No. 5,552,124 to Su renders any of claims 1, 2-3, and 5-6 unpatentable by suggesting a barrier having a first position relative to a wafer that facilitates etch uniformity for a chemically driven etch process and a second position that does not interfere with the etch uniformity of an ion driven etch process. (Claims 1, 2-3, and 5-6)

B) Whether U.S. Patent No. 6,042,687 to Singh, and/or U.S. Patent No. 5,552,124 to Su renders claim 4 unpatentable by suggesting a barrier having a multiple positions relative to a wafer and a chuck that is moved to establish the multiple positions of the barrier relative to the wafer. (Claim 4)

C) Whether U.S. Patent No. 6,042,687 to Singh, and/or U.S. Patent No. 5,552,124 to Su renders claim 7 unpatentable by suggesting a barrier having a first position relative to a wafer that facilitates etch uniformity for a chemically driven etch process, a second position that does not interfere with the etch uniformity of an ion driven etch process, and a third position. (Claim 7)

D) Whether U.S. Patent No. 6,042,687 to Singh, and/or U.S. Patent No. 5,552,124 to Su renders any of claims 8-9 and 11-13 unpatentable by suggesting a moveable barrier having a first position and a second position, wherein the first position is capable of restricting diffusion of gases over the wafer within the plasma processing apparatus to the wafer. (Claims 8-9, and 11-13)

E) Whether U.S. Patent No. 6,042,687 to Singh, and/or U.S. Patent No. 5,552,124 to Su renders claim 10 unpatentable by suggesting a moveable barrier having a second position and a first position that is within 1/8 inches to 2 inches of the wafer. (Claim 10)

(7) GROUPING OF THE CLAIMS

The rejected claims do not stand or fall together, and will be argued separately. The following claim groups will be argued separately.

I. 1, 2-3, and 5-6
II. 4
III. 7
IV. 8-9 and 11-13
V. 10

(8) ARGUMENTS

Claims 1-13 were rejected under 35 U.S.C. 103(a) as being unpatentable over Singh in view of Su.

In summary, the Singh describes a plasma processing system having a primary and secondary gas supply. The primary gas supply provides process gases to the processing chamber (see col. 4, lines 30-39). The secondary gas supply also provides a process gas, a secondary gas, to the processing chamber (see col. 4, lines 40-67). One suitable secondary gas supply described by Singh is a gas ring, which includes a number of orifices to deliver the gas. Other exemplary secondary gas supplies include a showerhead or nozzle arrangement.

Su describes a stationary focus ring for use in a plasma reactor during wafer processing. The stationary focus ring includes slots that allow a transfer blade and wafer to pass therethrough for wafer loading and unloading.

The Appellant's explanation of the differences between the above-cited references and the claimed invention will be discussed in the context of the each claim group. As explained below, the claims of all groups are patentable over Singh and Su for various reasons.

Group (I) Arguments

Appellants submit that there is no teaching in Singh or Su that would lead a person to combine these references, regardless of the system that such a combination might yield. Appellants further submit that one of the references indeed teaches against the other, and therefore the cited combination is not suggested or motivated by the cited prior art of record and thus is improper.

There is no suggestion in Su to combine the slotted focus ring described therein with a gas distribution system as disclosed in Singh. Further to the lack of motivation to combine the cited art in Su, Singh nowhere indicates that his gas distribution system would benefit from a slotted focus ring, as in Su.

More importantly, Singh directly teaches against the use of a focus ring. More specifically, Singh states "One problem with systems employing focus rings is that polymers generated from gaseous etch by-products or reactants are sometimes deposited on the focus rings. During subsequent substrate processing, this deposited polymer can cause undesirable contamination of the substrate being processed" (see Column 2, lines 15-30 of Singh). Thus, Singh expressly states that his gas distribution system would be compromised by a focus ring. Unmistakably, Singh teaches against focus ring usage. For at least this reasons, Appellants submit that combining the references – namely, combining the teachings of the gas distribution system of Singh with focus rings as described in Su – is improper.

Singh then concludes "There is thus a need for a scalable plasma processing system which provides uniform plasma processing across the surface of a substrate but without presenting the contamination problems inherent in focus/sacrificial ring systems" (column 1, lines 58-63). Focus rings are often referred to as diffusion barriers (see Singh, col. 1, lines 19-20). Undeniably, Singh teaches away from use of a focus ring, or a diffusion barrier as in the claimed invention.

Moreover, Singh expressly teaches against combination with Su. The previous cited quotations are taken with respect to focus rings in general. However, Singh expressly mentions that slotted focus rings, namely U.S. Patent No. 5,552,124 to Y.J. Su (see Column 2, lines 15-19 of Singh), are particularly problematic. Unambiguously, Singh specifically teaches against combination with Su. Therefore, Appellants submit that combining the references – namely combining the teachings of Singh with a slotted focus ring as described in Su – is improper.

For at least these reasons, Appellants submit that the asserted rejection is improper. Regardless, even if one combines the disclosures of Singh and Su, the cited art still does not teach or suggest claimed subject matter of claims 1, 2-3, and 5-6.

Appellants respectfully submit that none of the cited references, either alone or in combination, teach or suggest a barrier as described in independent claim 1. More specifically, none of the cited references teach or suggest "a barrier having a first position relative to the wafer wherein the first position relative to the wafer substantially facilitates etch uniformity for a chemically driven etch process, and having a second position relative to the wafer wherein the second position relative to the wafer does not interfere with the etch uniformity of an ion driven etch process."

Singh teaches against use of a focus ring, or a diffusion barrier, in chemical vapor deposition. More importantly, Singh does not teach use of a diffusion barrier in ion-assisted etch processes. Su describes a slotted focus ring for use in chemical vapor deposition. Similarly, Su also does not suggest the use of a diffusion barrier in ion-assisted etch processes. More importantly, neither reference suggests that a diffusion barrier not interfere with an ion-assisted etch process, as recited. Thus, neither references teaches or suggests "a barrier having a first position relative to the wafer ... and having a second position relative to the wafer wherein the second position relative to the wafer does not interfere with the etch uniformity of an ion driven etch process" as recited in claim 1.

Accordingly, Singh and Su, either alone or in combination, do not teach or suggest a semiconductor-based device processing apparatus as recited in claims 1, 2-3, and 5-6.

In addition to the inappropriateness in combining the cited references, Appellants submit that the references have been misinterpreted in the Office Actions. For example, on page 4, lines 4-6 of the Office Action mailed April, 24 2000, the Office Action misrepresents the teachings of Singh with: "The substrate support assembly includes a gas ring at both ends of the substrate. Such rings are referred to as focus rings which balance the gas flow above the substrate" (see page 4, lines 4-6 of the Office Action). This statement is incorrect. A gas ring is not the same as a focus ring and may not be used analogously therewith. A gas ring also may not be used to teach or remotely suggest a diffusion barrier. The gas ring 167 of Singh is a secondary gas supply that provides a gas to the processing chamber (see col. 4, lines 40-67). One exemplary secondary gas supply described by Singh is a gas ring that includes a number of orifices to deliver a gas. Other exemplary secondary gas supplies include a showerhead or nozzle

arrangement. Structurally, a gas injector is not analogous to focus ring or a diffusion barrier. Functionally, a gas inlet supplies process gases into the processing chamber (see Column 1, lines 34-45 of Su). A diffusion barrier, on the other hand, prevents the movement of gases.

Functionally or structurally, a gas ring is not analogous to a focus ring (or a diffusion barrier) and may not be used to suggest a diffusion barrier. Clearly, gas rings are not referred to as focus rings in Singh - as the Office Action asserts. The only mention of focus rings in Singh, as mentioned before, is with respect to teaching away from their use (col. 2, lines 15-40). This brief teaching against focus ring usage further compromises the Office Action assertion that "gas rings are referred to as focus rings". If the gas rings and focus rings were equivalent as inferred in the Office Action, why then would Singh propose a gas ring system when he plainly admonishes focus ring use?

Further, the teachings of Su have also been misinterpreted in the Office Action. For example, the Office Action states "Su discloses a moveable focus ring, which acts as a diffusion barrier... . The focus ring includes a slotted opening" (see Office Action dated April, 24 2000, page 3, paragraph 3). Appellants note that the slotted barrier of Su is not movable. Instead, the slotted barrier of Su is expressly stationary (see col. 4, lines 36-48).

The Office Action appears to have mistakenly combined the focus ring discussed in the background of Su with the slotted focus ring in the Detailed Description. Regardless, Appellants note that Su teaches against the focus ring discussed in the background. More specifically, Su notes "the focus ring tends to trap particulate contamination near the wafer edges. Such contaminants reduce die yield in that portion of the wafer near the wafer edges. Particulate contamination may also be trapped by moving parts within the chamber, for example, such as those that comprise the lift mechanism 15. When the lift mechanism is operated, resulting vibration tends to loosen and circulate contamination particles, thereby increasing the likelihood that such particles are deposited on the wafer surface. It is therefore desirable to reduce the complexity of the focus ring by eliminating the number of parts associated therewith, for example by producing a stationary focus ring" (emphasis added). Thus, Su clearly teaches against use of a movable barrier and moveable parts associated therewith.

In addition, as mentioned before, Su does not mention or remotely suggest "a barrier having a first position relative to the wafer ... and having a second position relative to the wafer wherein the second position relative to the wafer does not interfere with the etch uniformity of an ion driven etch process" as recited. It should be noted that while in the raised position, the lift

cylinder of Su may compromise an ion-assisted etch process. As mentioned before, a barrier near the wafer perimeter (such as the lift mechanism) may quench the plasma and thus disturb the ion density uniformity in the plasma, thus lowering the plasma density near the wafer perimeter and causing a non-uniform etching during an ion assisted/driven etch.

In summary, the cited art does not teach or suggest claimed subject matter of claims 1, 2-3, and 5-6, the Office Action has misinterpreted the teachings of both references, and the cited combination is improper for multiple reasons, each of which would have prevented one of skill in the art proper motivation to have combined the references.

Accordingly, it is respectfully submitted that claim 1 is patentable over the cited art. Claims 2-3, and 5-6 each depend directly or indirectly from claim 1 and are therefore patentable for at least the reasons that claims 1 are patentable over the art.

Group (II) Arguments

With respect to issue B, claim 4 requires all the limitations of claim 1. Therefore, claim 4 is patentable over the cited art for at least the reasons presented above with respect to Group I. Claim 4 additionally recites that the chuck be moved to establish the first and the second position of the barrier relative to the wafer.

With respect to claim 4, the Examiner has not stated how claim 4 is taught or suggested by the art of record. Regardless, Appellants note that the art of record does not include a moveable chuck that is moved to establish the first and the second position of the barrier relative to the wafer. Appellants note that the lift pins of Su do not alter the position of the barrier relative to wafer during wafer processing. In contrast, the lift pins of Su lift the wafer so a wafer transfer blade may slide underneath for wafer transportation. Regardless, neither Singh nor Su teaches that the chuck is moved to establish multiple positions of a barrier relative to the wafer.

Both Singh and Su fail to teach or suggest the element required in claim 4 of "wherein the chuck is moved to establish the first and the second position of the barrier relative to the wafer." Accordingly, it is respectfully submitted that claim 4 is patentable over the cited art.

Group (III) Arguments

With respect to issue C, claim 7 requires all the limitations of claim 1. Therefore, claim 7 is patentable over the cited art for at least the reasons presented above with respect to Group I. Claim 7 additionally recites that the barrier has a third position.

As described in the Specification, the third position may include various positions between a recessed position that does not compromise an ion driven process and an elevated position where it functions as a diffusion barrier. The third position may also include any non-intrusive positions of a barrier above an electrostatic chuck (see Specification, for example, on page 6, line 20 to page 7, line 16).

As Singh and Su fail to teach or suggest a barrier "having a second position relative to the wafer wherein the second position relative to the wafer does not interfere with the etch uniformity of an ion driven etch process" (claim 1), they likewise do not teach the barrier having a third position as recited.

Thus, both Singh and Su fail to teach or suggest the element required in claim 7 of "wherein the barrier has a third position." Accordingly, it is respectfully submitted that claim 7 is patentable over the cited art.

Group (IV) Arguments

Claims 8-9 and 11-13 pertain to a moveable barrier having a first position and a second position, wherein the first position is capable of restricting diffusion of gases over the wafer within the plasma processing apparatus to the wafer.

As discussed above with respect to Group I, Appellants submit that the rejection under 35 U.S.C. 103(a) is improper. More specifically, there is no suggestion in Su to combine the slotted focus ring described therein with a gas distribution system as in Singh, and no suggestion in Singh that his gas distribution system would benefit from a slotted focus ring as in Su. In addition, Singh teaches against the use of focus rings in general, further making the combination improper (see Column 2, lines 15-30 of Singh). Singh also expressly and specifically teaches against Su and his slotted focus ring (see Column 2, lines 15-19 of Singh). Clearly, combining the references – namely combining the teachings of Singh with focus rings of Su – is improper.

Singh also expressly teaches away from focus ring usage. More specifically, "One problem with systems employing focus rings is that polymers generated from gaseous etch by-products or reactants are sometimes deposited on the focus rings. During subsequent substrate

processing, this deposited polymer can cause undesirable contamination of the substrate being processed" (see Column 2, lines 15-30 of Singh). Focus rings are often referred to as diffusion barriers (see Singh, col. 1, lines 19-20). The present invention claims a diffusion barrier. Thus, Appellants submit that Singh teaches away from the present invention.

Furthermore, Singh contradicts the prior art combination proposed by the Examiner. The Office Action asserts it would have been obvious for one of skill in the art "to modify Singh with the moveable focus ring of Su since Su also uses focus rings as a diffusion barrier" (see Office Action mailed April, 24 2000, page 3, paragraph 4). Appellants respectfully disagree. Su does not use a moveable focus ring. He uses a stationary focus ring with slots. Secondly, Singh does not use a focus ring as implied in the Office Action assertion. In fact, Singh teaches against their use, and the Office Action assertion to the contrary contradicts the teachings of Singh. Thus, the Office Action has not provided any legitimate motivation to combine the references.

In summary, Appellants submit that one of skill in the art would not have been motivated to combine Singh and Su as proposed in the Office Action. In addition, as described above, the cited art does not teach or suggest claimed subject matter of claim 8.

Accordingly, it is respectfully submitted that claim 8 is patentable over the cited art. Claims 9 and 11-13 each depend directly or indirectly from claim 8 and are therefore patentable for at least the reasons that claim 8 is patentable over the art.

Group (V) Arguments

With respect to issue E, claim 10 requires all the limitations of claim 8. Therefore, claim 10 is patentable over the cited art for at least the reasons presented above. Claim 10 additionally recites distances between the barrier and the wafer.

Appellants note that Su teaches against proximity between a moving barrier and a wafer. More specifically, he states "the focus ring tends to trap particulate contamination near the wafer edges. Such contaminants reduce die yield in that portion of the wafer near the wafer edges." As Singh teaches that a moving focus ring in proximity to the wafer may lead to contamination and compromise of the wafer, he therefore does not suggest desirable distances between the barrier and the wafer as recited. For at least these reasons, claim 10 is patentable.

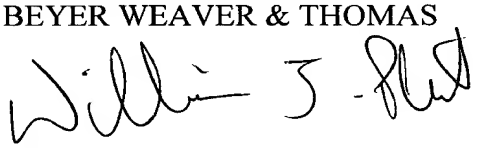
Thus, both Singh and Su fail to teach or suggest the element required in claim 10 of "wherein at least a portion of the moveable barrier is within 1/8 inches to 2 inches of the wafer

when in the first position." Accordingly, it is respectfully submitted that claim 10 is patentable over the cited art.

Conclusion

Regarding all the rejections, the cited references Singh and Su fail to teach or suggest elements required in the pending claims. This is true regardless of whether these references are considered alone or combination with one another. In view of the foregoing, it is respectfully submitted that none of the pending claims are rendered unpatentable by the patents to Singh and/or Su. Accordingly, the pending rejections of all of the claims under 35 U.S.C. § 103(a) should be reversed.

Respectfully submitted,
BEYER WEAVER & THOMAS



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(9) APPENDIX

1. A semiconductor-based device processing apparatus comprising:

a chuck for supporting a wafer; and

a barrier having a first position relative to the wafer wherein the first position relative to the wafer substantially facilitates etch uniformity for a chemically driven etch process, and having a second position relative to the wafer wherein the second position relative to the wafer does not interfere with the etch uniformity of an ion driven etch process.

2. The apparatus as recited in claim 1 wherein the barrier is moved to establish the first and the second position of the barrier relative to the wafer.

3. The apparatus as recited in claim 2 wherein the first position is substantially above the wafer and the second position is substantially below the wafer.

4. The apparatus as recited in claim 1 wherein the chuck is moved to establish the first and the second position of the barrier relative to the wafer.

5. The apparatus as recited in claim 1 wherein the barrier surrounds the periphery of the wafer.

6. The apparatus as recited in claim 1 wherein the barrier is moved between the first and the second position using an actuator.

7. The apparatus as recited in claim 1 wherein the barrier has a third position.

8. A plasma processing apparatus comprising:

a chuck for supporting a wafer; and

a moveable barrier having a first position and a second position, wherein the first position is capable of restricting diffusion of gases over the wafer within the plasma processing apparatus to the wafer.

9. The apparatus as recited in claim 8 wherein the plasma processing apparatus further comprises an actuator operable to move the moveable barrier between the first position and the second position.

10. The apparatus as recited in claim 8 wherein at least a portion of the moveable barrier is within 1/8 inches to 2 inches of the wafer when in the first position.

11. The apparatus as recited in claim 8 wherein the moveable barrier includes an opening.

12. The apparatus as recited in claim 8 wherein the moveable barrier shape is relative to the shape of the wafer.

13. The apparatus as recited in claim 12 wherein the moveable barrier shape is substantially circular.